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ABSTRACT

This paper describes the arguments made for using interdisciplinary approaches in school curriculum. Specifically examined are the historical antecedents that inform discussions of interdisciplinary studies; how interdisciplinary studies are organized; whether differences exist across content areas; general assumptions made about teaching and learning; and how interdisciplinary studies are presumed to improve upon traditional approaches to school curriculum. The review focuses on frameworks, justifications, and reasons that may be built partly on empirical evidence and also on assumptions about teaching and learning not easily reduced to empirical facts. An extensive ERIC search was conducted. Following examination of these initial 150 documents, other relevant resources and bibliographies were examined. Additionally, an analysis of curriculum standards published by professional teaching organizations determined if justifications for interdisciplinary studies were provided in these documents. Coordinating disciplines has been a primary feature of curriculum planning since the turn of the century, but is seldom seen in modern schooling. Recently, however, research in cognition and projected demands from the 21st-century workplace have brought pressures for a more connected vision of the curriculum. Both brain response and higher-order thinking tasks were found to demand authentic, complex, multiple, and concrete problem-solving experiences. Many terms are used in the literature--core, interdisciplinary, fusion, integrated, cross-disciplinary, correlated, integrative, and trans-disciplinary. Three representations stand out: interdisciplinary, integrated, and integrative. All three approaches attempt to connect the student with the abstract world of disciplinary knowledge and the real world of experience. (Includes two tables of models; contains 124 references.) (NKA)

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THE LOGIC OF INTERDISCIPLINARY STUDIES

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THE LOGIC OF INTERDISCIPLINARY STUDIES

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INTRODUCTION

The idea of combining two or more disciplines, pedagogical approaches, groups of people, or skills is not new. First appearing in curricular contexts in the 1920s under the title 'core,' interdisciplinary and integrated curriculum have been widely associated with the progressive education movement (Oberholzer, 1937; Vars, 1991). Tyler (1949) saw integration as the horizontal connections necessary for a coherent curriculum, and Bloom (1958) advocated for an inquiry-oriented, integrated curriculum that "open(ed) up possibilities," understanding and relevance.

Some curricular integration has been fairly widespread (although not without controversy), as in the case of whole language, which became popular in the late 70s. Whole language emphasizes language instruction through immersion in authentic use instead of through rote learning of isolated words and sounds (Altweger, et al., 1987; Dybdahl & Shaw, 1993). Similarly, there has been a growth of combined courses in the physical, natural, and social sciences following the recommendations of several reports, such as those by the National Association for the Advancement of Science (1988); the National Council of Teachers of Mathematics (1989); and the Bradley Commission on History in Schools (1988). All advocate for an authentic and connected curriculum for all students, instead of the more prevalent specialized, in-depth study by select groups of students (Aschbacher, 1991; Brunkhorst, 1991; Tchudi, 1991).

Proceeding from these initiatives, but closely tied to the latest reform efforts, is a rapidly swelling wave of new interdisciplinary/integrated developments. The main goal of these latest reforms is to help students synthesize discrete information and to connect such knowledge to the needs of everyday living. Some general themes emerging from this movement are:

- the criticism of isolated disciplines as static and removed from the reality of everyday experiences (Braunger & Hart-Landsberg, 1994; Hurd, 1991; Nielsen, 1989; Tanner, 1989);

- the inclusion of personal knowledge, experiences, or points of view as relevant to the development of overall learning (Beane, 1992, 1995; Harter & Gehrke, 1989; Hurd, 1991; Kovalik & Olsen, 1994; Nielsen, 1989; St Clair & Hough, 1992; Yager, et al., 1981);

- pedagogical approaches that place research and inquiry skills in the center of curricular organizing (Berlin & White, 1994; Martinello & Cook, 1994; Marzano, 1994; McBride & Silverman, 1991; St Clair & Hough, 1992); and

- the view that learning about or forming connections between fields of knowledge is an essential educational need for success in the 21st century (Boyer, 1991; Caine & Caine, 1991; Dwyer, 1995; Jacobs, 1989; Martinello & Cook, 1994; Nielsen, 1989).

Although these educational trends suggest a common pedagogy, their epistemological unity is far from clear. Generally, educators are jumping on the bandwagon without adequately questioning the nature of the dissatisfaction with discipline-specific approaches, or taking the time to shape a coherent approach to interdisciplinarity (Relan & Kimpston, 1991; Brophy & Alleman, 1991; Gibbons, 1979; Klein, 1992; Wicklein & Schell, 1995). Many models have been suggested, but few have gone so far as to ask, as Gibbons (1979) has: "What, logically, happens when concepts and propositions from different disciplines are brought together in a synthesis?" (p. 323).

The purpose of this paper is to describe the arguments, including justifications and reasoning, made for using interdisciplinary approaches in school curriculum. Specifically, what are the historical antecedents that inform discussions of interdisciplinary studies? How are interdisciplinary studies organized? Are there differences across content areas? What general assumptions about teaching and learning are made? And how are interdisciplinary studies presumed to improve upon traditional approaches to school curriculum? This review does not examine the empirical evidence about whether or not interdisciplinary studies 'work.' There is precious little research of this sort, and the focus here is on frameworks, justifications, and reasons that may be built in part on empirical evidence but also on assumptions about teaching and learning that may not be easily, if at all, reduced to empirical facts.

Methodology

For this review, an extensive ERIC search was conducted. From the initial approximately 150 documents other relevant references and bibliographies were examined. The literature upon which this review is based extends beyond those initial references to include historically relevant literatures and references not necessarily found through an ERIC search. An attempt was made to review a wide cross-section of articles and books that answered, at least in part, the questions posed in the introduction. Works that dealt solely with the integration of vocational and academic track students were not included; nor were those that merely described interdisciplinary units without providing a rationale for them. The main criteria for inclusion was whether a rationale for or against interdisciplinary studies was evident, or whether the document provided information on organizational frameworks for facilitating interdisciplinary approaches.

Additionally, an analysis of curriculum standards published by the National Council for Social Studies (1989), the International Reading Association and the National Council of Teachers of English (1996), the National Council of Teachers of Mathematics (1989), and the National Research Council (1996) was done to determine if justifications for interdisciplinary studies were provided in these documents.

Historical Influences

Coordinating disciplines has been a primary feature of curriculum planning since the turn of the century when Herbart's notion of 'apperceptive mass' changed the way theorists conceptualized the sequencing of learning. Since then, articulation within the disciplines and across the K-12 curriculum has been a prime focal point of educational discourse (Harvill, 1954). How the curriculum has been articulated, however, has closely paralleled contemporary social issues, even though educators have consistently warned against the "fatal disconnection of subjects which kills the vitality of our modern curriculum" (Whitehead, 1929, pp. 10-11). More often than not it has been the voices of science and economics that have shaped the curriculum (Cohen, 1978). Industrial efficiency studies and scientific thinking characterized by objective, quantifiable measurement has led to the assumption "that complex tasks become more

manageable (i.e. easier) once broken down into their so-called basic parts" (Iran-Nejad, 1994, p. 63). This "simplification-by-isolation" has dominated the structure of the curriculum to this time and is probably the main force against the advance of integrated models.

Knudsen (1937) states that in 1855, the British psychologist Spencer advanced the notion of integration as being the final adjustment of a changing organism, or the more or less successful completion of its growth depending on the nature of the environmental input. This evolutionary concept was quickly adopted by psychology, neurology, and physiology to indicate the stability of a whole organism, or the successful completion of adaptation of an organism that had been temporarily displaced or disturbed. Around 1916, Gestalt psychology popularized the notion that all parts of a system or organism can only be defined or understood by their relation to the whole (Relan & Kimpston, 1991). Furthermore, organismic psychology (as Gestalt was called in the United States) promoted a school curriculum that reflected an interconnected, authentic environment that presumably provided maximum relevance or meaning to the whole child (Harvill, 1954; Knudsen, 1937).

Integration was seen on the one hand to be a means (the interactions, adaptations, and influences of parts of a system on the whole) and on the other hand to be an end (the successful completion of the growth of an organism) (Knudsen, 1937). The view of integration as a means is apparent in the vast body of research in cognition. During the 1960s, Piaget's constructivist psychology and Bruner's structural cognitivism influenced the development of many innovative courses (Gozzer, 1982). Knowledge was viewed as 'something becoming,' something to construct through active inquiry (Foshay, 1970). Learning was not simply the accumulation of facts but was believed to induce the restructuring of the learner's cognitive structure or organization (Marzano, 1991). Knowledge was increasingly seen as a complex, interconnected system requiring new pedagogical methods for successful learning to take place. Situated cognition, thematic organizers, and concept mapping have been ways of developing more receptive and connected curricula for students. Many such pedagogical concepts have been fundamental in shaping current interdisciplinary and integrated models. For example, Ausubel held "that the most stable useful knowledge is that which focuses on general, highly abstract concepts"; while Novak concluded, "learning is not as dependent upon various 'stages' as it is upon a framework of concepts and the integration between these concepts" (Nielsen, 1989, p. 20).

The view of integration as an end is associated with the growth in a child-centered curriculum that takes into account the whole child, including physical, emotional, social, and cognitive needs. In holistic approaches "knowledge is perceived within experience and cannot be separated from the personal meaning given to it by the individual" (Crowell, 1995, p. 13). Looking at a system through juxtapositions of its interacting parts has developed into a movement called general systems theory, and has influenced how research is conducted within the sciences as well as other fields (Cohen, 1978). For example in the field of anthropology, Lynd (1939), wrote: "The failure of the social sciences to think through and to integrate their several responsibilities for the common problem of relating the analysis of parts to the analysis of the whole constitutes one of the major lags crippling their utility as human tools of knowledge" (p. 15).

Why then is interdisciplinarity so seldom seen in modern schooling? The reaction against integrated curriculum has not been a reaction to the content, but a reaction to the critical attitudes engendered through the pedagogy (Cohen, 1978). Progressive educators like Dewey, an early proponent of an integrated curriculum, saw curriculum as a means to developing the critical attitudes in students that would enable them to participate as informed citizens in a democracy. Critical thinking goals, however, have either lost or gained popularity in direct relationship to socio-political events. For example, during the 1950s, the suspicion engendered by McCarthyism gave rise to increased censorship of the curriculum and the association that holistic education was somehow unpatriotic (Tanner, 1989). Similarly, the economic crises of the 1980s brought about severe cutbacks in any curriculum that was considered alternative; such 'frills' were often blamed for the lowering of student achievement.

Recently, however, research in cognition and projected demands from the 21st century workplace have brought new pressures that have turned the tide once again to a more connected vision of the curriculum. During the last fifteen years, research in cognition has shifted from focusing on knowledge structures to looking at how the brain or nervous system responds to these structures, as well as differentiating the needs of lower-order versus higher-order thinking functions. Both brain response and higher-order thinking tasks were found to demand authentic, complex, multiple, and concrete problem-solving experiences (Caine & Caine, 1991; Iran-Nejad, 1994; Marzano, 1991). This, coupled with espoused workplace needs, which have advanced that all students need the skills to adapt, analyze, organize, and interpret fast-paced, multidimensional

information, has promoted a more integrated approach to vocational and academic tracks, and has influenced how such essential skills as writing, reading, critical thinking, and problem solving are to be disbursed within and across the curriculum (Burns, 1995; Brunkhorst, 1991; Dwyer, 1995). A look at the recent curriculum standards for English, social sciences, mathematics, and the physical/natural sciences (International Reading Association & National Council of Teachers of English, 1996; National Council of Social Studies, 1989; National Council of Teachers of Mathematics, 1989; National Research Council, 1996) confirms the wide support given to the notion that furthering connections between disciplines is a viable pedagogical approach. Therefore, one reason the contemporary response to calls for integration has been more favorable is that the global, yet personally relevant, thinking curriculum, once associated only with the progressive movement, has been adopted both by science and economics, thus giving it validity. Let it be said, though, that there are forceful arguments proffered for a discipline based, anti-holistic curriculum as well.

What Is Meant by 'Discipline'?

Before describing the meaning of interdisciplinarity it is useful to examine what is meant by 'discipline.' Gozzer (1982) states that a 'discipline' is "a process in which learning finds expression" (p. 286). More specifically he states: "Disciplinarity appears to be a compartmentalization determined by the need to gain thorough knowledge of the various aspects of each cognitive area: thus, criteria of reflection and study appropriate to each sector are determined, and there is a certain crystallization of the various fields of inquiry, defined by their characteristics of observability, method and application" (p. 286). Nissani (1995) defines a discipline "as any comparatively self-contained and isolated domain of human experience which possesses its own community of experts. Every discipline has its peculiar constellation of distinctive components: such things as shared goals, concepts, facts, tacit skills (Polanyi, 1962), methodologies, personal experiences, values, and aesthetic judgments"(p. 122). According to Churchman, "Each of the disciplines is really set up tentatively as an intellectual hypothesis on learning"; however, the problem is that what starts as a hypothesis becomes a conviction and "sees itself as the foundation for all learning" (1981, p. 47). Subdisciplines are also formed every

day. Like today's newer courses (i.e., 'women's studies', 'environmental studies', or 'multiculturalism'), older disciplines emerged claiming their independence from leading disciplines such as theology and philosophy (Stember, 1991).

What happens to the disciplines in interdisciplinarity? Are they linked, combined, restructured, transformed? Some theorists, like Romey (1975) and Kovalik & Olsen (1994), suggest that keeping any notion of discipline in interdisciplinary or integrated models extends their overall influence and harms progress towards true learning models. Beane (1995), although agreeing, contends it is not the disciplines that are to be blamed for the staleness of curricular models, but the stripped-down, narrowly conceived, partial representations of these disciplines in the classroom. However, most theorists see the disciplines as necessary stepping stones between current curricular approaches and truly integrated models of curriculum (Jacobs, 1989; Drake, 1991). Starting with what exists, these researchers suggest, carries with it a greater likelihood of long-term successful implementation of interdisciplinary models.

The degree to which the content of each discipline must be retained and the depth of integration in interdisciplinary approaches are only vaguely addressed in the literature. Some guidelines are given, but these are of a theoretical nature. One of the more detailed accounts is provided by Ackerman (1989) who proposes three guidelines for assessing the role of the disciplines in interdisciplinarity. These are: (a) content and connections should hold "validity within the disciplines" that requires verification that the concepts are important to the disciplines; (b) concepts must also hold "validity for the disciplines" in that they actually enhance learning of the discipline; and (c) interdisciplinary concepts must have "validity beyond the disciplines" in that they "provide a greater understanding of complex issues in the world" (pp. 27-29).

Some Definitions

There are many terms used in the literature—interdisciplinary, core, fusion, integrated, cross-disciplinary, correlated, integrative, trans-disciplinary. Defining each and every term would only serve to obfuscate the critical underlying assumptions, as even definitions of the same word often contradict each other. What this multitude of meanings does express, however, is how unsettled and unclear the concept of interdisciplinarity really is. Most theorists present their definitions

along a continuum, with discipline-specific examples on one end and totally integrated examples on the other. The wording and magnitude of the range vary. For example, Fogarty (1991a, 1991b) presents ten models, from 'Fragmented' to 'Networked,' while Jacobs (1989) describes six models ranging from 'Discipline Field' to 'Transdisciplinary.'

These attempts to compartmentalize what is known about interdisciplinarity suggest the need for explicating a logic for interdisciplinary studies. Because such a variety of terms are used to describe surface features of interdisciplinary curriculum, it seems more productive to examine the different theoretical features that underlie these descriptions. When looked at in this way, three representations stand out: interdisciplinary, integrated, and integrative. These representations are briefly outlined in Table 1.

TABLE 1: LEVELS OF INTEGRATION

intradisciplinary **discipline-field**	• enhances connections within disciplines • promotes success for all students
cross-disciplinary **correlated**	• coordinated themes/content across separate subjects • emphasis of certain skills across disciplines
interdisciplinary	• processes, concepts, skills, or elements of two or more disciplines together • common themes or modes of inquiry form interdisciplinary connections • inquiry skills and discipline content are enhanced
integrated	• disciplines lost in global perspective • theme or issue oriented • inquiry oriented
integrative	• disciplines lost in global perspective • student/teacher negotiated themes and issues directed • inquiry oriented

Squires (1975) defines an interdisciplinary course "as one in which two or more disciplines are taught in conscious relation to one another" (p. 7). Jacobs (1989) defines an interdisciplinary curriculum as "a knowledge view and curriculum approach that consciously applies methodology and language from more than one discipline to examine a central theme, issue, problem, topic, or

experience" (p. 8). Views described as multidisciplinary, crossdisciplinary, pluridisciplinary, and correlated all share the critical elements of this view. The critical element is that regardless of whether it involves skills, concepts, content, points of view, or methods, interdisciplinarity always involves bringing together two or more things under one roof. And this is done in a conscious manner, for example through team teaching (Ballard & Anderson, 1994), by coordinating the contents of separate courses (Palmer, 1991), by teaching two subjects together (McBride & Silverman, 1991), or by exploring a general theme through various discipline-based activities (McDonald & Czerniak, 1994). Still, the content, methods, processes or skills taught remain bound to the primary discipline from which they come.

Whereas interdisciplinarity seeks to combine disciplines to enhance the learning in one or more of the disciplines, or to apply discipline-based methods to real life situations, integration seeks to transcend the disciplines toward a more interconnected vision of the universe. Knowledge is seen as an abstract whole to be accessed through inquiry of themes, issues, experiences, and problems. Knowledge traditionally bound to disciplines still plays an important part in learning, but as samples of knowledge representations not as knowledge itself. "To integrate, logically speaking, is to unify parts so that the result is more than the sum of these parts" (Gibbons, 1979, p. 321). Proponents of an integrated curriculum suggest much is being missed when knowledge is separated into categories and treated hierarchically. Instead of defining basic skills as prerequisite to higher-order/critical thinking, integrated or integrative approaches view critical thinking within large, complex themes as a necessary background to fact acquisition.

Dressel (1958) in the conclusion of the NSSE Yearbook, differentiates between integrated and integrative. Integrated, he explains, is when a teacher presents a unified or integrated conception of some form of knowledge to the student, whereas an integrative curriculum places students in a participatory role in the formation of integrated views. In an integrative approach "the 'integration' is done by the person him or herself; it is not done for that person by others" (Beane, 1992, p. 49). In other words, the main difference lies in who decides the curricular content and what is emphasized in the goals (Braunger & Hart-Landsberg, 1994; Burns, 1995).

In summary then, an *interdisciplinary approach* always consciously combines two or more disciplines and keeps them distinct and in focus. It has clear objectives that include both critical-

thinking skills and in-depth content, and is typically teacher directed but may welcome student input. An *integrated approach* transcends disciplinary-bound knowledge in the exploration of a more unified and realistic view of knowledge. It is inquiry oriented and usually thematically based, and the themes and activities are teacher picked and directed. The goals are structured and include content, skills, and processes. Finally, an *integrative approach* starts with students' and teachers' concerns and ideas, transcends the disciplines in a search for coherence and meaning, and is built through daily negotiations and interactions. The goals are more affective and include such goals as personal relevance, collaboration, and citizenship skills.

Models

What is evident in the interdisciplinary, integrated, and integrative approaches is the conscious effort to provide students with more meaningful learning experiences. All three approaches attempt to connect the student with the abstract world of disciplinary knowledge and the real world of experience. This two-pronged intent results in a consistent conflation of combining disciplinary knowledge, skills and processes with pedagogical principles. In other words, interdisciplinary/integrated/integrative approaches are not simply attempts to combine two or more knowledge bases, but also to do so in ways that are more inquiry oriented, hands-on, and connected to the real world.

Relan & Kimpston (1991) ask: "How feasible is it to integrate separate structures, biases, conflicts and language of disciplines?" (p. 6) How should such a curriculum be organized? What is gained and what is lost? How can the quality or success of an integrated curriculum be evaluated? And are there distinguishable necessary components that are involved in the formation of interdisciplinary models? The literature proposes a number of models for creating these new curriculums and this section of the paper will describe these through an analysis of common features.

TABLE 2: GENERAL FEATURES OF INTERDISCIPLINARY, INTEGRATED, AND INTEGRATIVE MODELS

discipline represented	historical influences	role of teacher	goals for students	nature of knowledge	integrative 'threads'	proponents
INTERDISCIPLINARY						
math/science	cognition constructivism curriculum standards	authoritarian	content coverage higher order thinking skills application motivation	discipline experiential cognitive	inquiry methods content processes objectives	Berlin & White (1994) McBride & Silverman (1991) Krupnik & Gottlieb (1995) Davison, et al. (1995)
social science/ language arts	whole language general systems curriculum standards	authoritarian	content coverage inquiry skills application motivation	discipline social personal	time places themes issues content objectives	Ballard & Anderson (1994) Zarnowski (1994) Farivar (1993) Moss (1991) Coate & White (1996)
science technology society	general systems progressive education citizenship education	visionary guide	citizenship decision-making skills inquiry skills	experiential social personal	issues	Yager, et al. (1981) Heath (1989) Hurd (1991) Fagan (1989)
INTEGRATED						
those relevant to the theme & others	constructivism cognition general systems	visionary guide	higher order thinking skills inquiry skills application motivation cooperative skills	experiential cognitive	inquiry methods themes issues	Palmer (1991, 1995) Marzano (1994) Martinello & Cook (1994) Shoemaker (1991) Harber & Gehrke (1989) Drake (1991)
INTEGRATIVE						
those relevant to the theme & others	gestalt psychology progressive education citizenship education social reconstructivism	mediator negotiator	affective citizenship decision-making skills critical thinking collaborative skills	social personal experiential	themes issues	Beane (1992, 1995) Davenport & Jaeger (1995) Pate, et al. (1995) Nielsen (1989) Kovalik & Olsen (1994) Clark (1986)

The general method of developing these models is through what Bloom (1958) described as 'integrative threads'. The intention of these threads is to combine disciplines through major ideas or themes; to approach problems using inquiry methods from chosen disciplines; or simply to connect and to compare knowledge from various sources. These 'threads' are evident in 'thematic webs' (Nielsen, 1989), 'planning wheels' (Palmer, 1991), 'integrative kaleidoscopes' (Harter & Gehrke, 1989), and 'concept maps' (McDonald & Czerniak, 1994).

Many theorists (Berlin & White, 1994; Davison, et al., 1995; Fogarty, 1991; Jacobs, 1989; Oja, et al., 1995; Pettus, 1994; Wicklein & Schell, 1995; Yager, et al., 1981) offer multiple models along a continuum to provide teachers with options to explore, discuss, and alter to fit their needs. Along this continuum are typically found examples of interdisciplinary, integrated and integrative models.

Interdisciplinary Models

There are many configurations in the interdisciplinary category. These are influenced first by the specific goals for which they were designed, which direct the subjects, skills, or processes involved. For example, in the PHYS-MA-TECH (physics, mathematics, and technology) model, Scarborough (1993a) makes explicit that the goal of the project is "to enhance physics so that 'average' students would be more inclined to enroll in high school physics" (p. 26). In other words, one (or more) disciplines are used to enhance or facilitate learning in a primary discipline. Dybdahl and Shaw (1993) provide another example of this approach when they combined literature and science to make the science content more interesting and meaningful. The literature, they said, had educational value, but the primary emphasis was the science.

Most interdisciplinary models, however, seek to combine disciplines in order to enhance both disciplines, as well as to provide a better understanding of how the disciplines connect with each other and with the world around them. Examples of this are Coate and White's (1996) eighth grade history and English core where both history and language arts are equally important and equally balanced through thinking, reading, writing, and speaking activities, and McBride and Silverman (1991) who reason that the shared forms of inquiry and reasoning in mathematics and science will enhance the understanding of both if taught together.

In most interdisciplinary models inquiry skills are a primary goal. The nature of that inquiry varies, and includes hands-on problem-solving activities, inquiry into a social era or topic, or inquiry into a theme or issue. Integrated mathematics and science proponents cite their similar reasoning strategies, inquiry methods, and content as the reason for their integration (Berlin & White, 1994; Davison, et al., 1995; McBride & Silverman, 1991). On the other hand, it is the similarity in objectives, such as cultural awareness, critical thinking, and informed decision making, that typically bind language arts and social science (Norton, 1988; Farivar, 1993). Both contexts, however, seek to emulate the real world while providing students with an arena for problem-solving and decision-making activities.

Integrated Models

These models can be best viewed as a bridge between interdisciplinary and integrative models. Most often designed by teachers who have strong global interests, integrated studies go beyond interdisciplinary approaches in that discipline-transcending concepts and problems are central to the curriculum, yet they can still be considered interdisciplinary if pursued within an interdisciplinary framework. For instance, the science, technology, society courses (S.T.S.) (Fagan, 1987; Heath, 1989; Hurd, 1991; Yager, et al., 1981) limit their focus to the relationship of science to society but are conceptually integrated since the primary focus is the larger socio-scientific picture rather than the coverage of science. "The very notion of 'integration' incorporates the idea of unity between forms of knowledge and their respective disciplines. 'Interdisciplinary' on the other hand simply refers to the use of more than one discipline in pursuing a particular inquiry" (Pring, 1973, p. 135).

In integrated approaches, the pedagogy is issues oriented and the teacher is someone who is aware "of the needs, problems, and interests of the community and the society where he or she lives and teaches" (Yager, et al., 1981, p. 12). Whereas in interdisciplinary models, the content, process, or methodology can be the organizing feature, integrated models are organized around abstract themes or global issues.

Many educational groups like the American Association for the Advancement of Science or

the Bradley Commission on History in Schools argue for vital themes that cut across subject matters (Brunkhorst, 1991; Tchudi, 1991), and many curriculum committees are adopting thematic 'strands' that provide the flexibility for individual groups to incorporate them into interdisciplinary, integrated, or integrative schemas as desired. For example, in Eugene, Oregon three major strands are "Human Societies," "The Earth and the Universe," and "The Individual" (Shoemaker, 1991). The rationale for theme-oriented units is that they provide focus while also giving a global view of the interrelationships within the world (McDonald & Czerniak, 1994).

Thematic webbing, as described by Nielsen (1989), for example, is a standard way of developing an integrated model. An interested group of teachers get together and brainstorm global themes, for example: change, communication, or patterns. Then 'threads' are spun out from the central theme, forming a web of multiple, discipline-transcending units. From these units, questions and problems are shaped into lessons. One criterion stressed by Nielsen is that these overriding themes must not be simplified topics (e.g. sharks, bicycles), but global, abstract themes "capable of evoking class discussions regarding large, rather profound ideas" (p. 23). Presumably, the more abstract, ambiguous and generalizable the theme, the more relevant it is across disciplinary domains (Nielsen, 1989; Tchudi, 1991).

Unlike themes, issues are controversial topics that entail diverse perceptions and opinions, such as abortion, genetic engineering, or energy (Hurd, 1991; Yager, et al., 1981). Issues seek to raise the critical awareness of students, enhance their ability to make judgments in the face of controversy, and increase their understanding of and tolerance for contrary opinions. For example, "Issue-focused science education fosters students' involvement, enabling them to feel that they have a stake in potential solutions and possible future actions" (Yager et al, 1981, p. 13). Issues, like themes, become the springboard for units, guest speakers, and projects.

Although student perspectives are important and are included and explored in relation to the theme or issue, the teacher (or more often team of teachers) is generally viewed as a leader with expert knowledge in one area, while having the interest and willingness to view themselves and their particular discipline in a collaborative context.

Integrative Models

The integrative approach creates a different frame for learning and casts teachers and students as partners in curriculum design. Like the integrated approach it is organized by themes and issues, but it emphasizes the personal interests, and cultural and affective nature of the student more than the other models described. Personal meanings, choices, and constructions are accepted as valued components of the learning environment. "This personalization is a part of the constructivist philosophy because, as students participate, they develop an internal and unique, integrated view of learning, society and the world" (McDonald & Czerniak, 1994, p. 9). In integrative models knowledge is not viewed as information to be 'covered' but as multidimensional, highly personalized schemas 'owned' and used to create "generalizations, analogies, explanations and connections" (Maurer, 1994, p. 7).

Beane (1991, 1992, 1995) has advocated strongly for an integrative approach at the middle school level. "The theory behind this approach is that authentic and significant learning occurs as new experiences are integrated into our scheme of meanings in such a way that those meanings are expanded and extended" (Beane, 1992, p. 49).

Contrary to what some believe, students do not do what they want. Teachers facilitate discussions, provide resources, and guide inquiry; but they also have the responsibility to encourage and make sure that students pursue inquiry in fields in which they have little knowledge or interest. Daily negotiations surrounding issues of necessary skills and content means students have a stake in what is taught and how. In one such classroom, the students had concluded an in-depth study of human rights issues from the 1600s to the present. The teachers thought that developing a timeline might give them a good idea of how much the students had learned. When they proposed such a project, they wrote of their observations: "Students looked at each other and then at us. They said they had learned too much for a 'simple' timeline. So we asked them how <u>they</u> wanted to demonstrate what they had learned. The students brainstormed, and ideas started flowing. They all wanted to 'do something big.' The students ended up constructing a 'Living History Timeline' based on historical events of human and civil rights. They chose issues and events to reenact. They wrote scripts and created scenery backdrops. The 'Living History Timeline' depicted eleven events ranging from the Salem Witch Trials to Bosnia/Herzegovina" (Pate, et al., 1995, p. 64).

The main principle underlying a negotiated environment is the development of views and behaviors necessary for responsible participation in a democracy. "As a result of the negotiated engagement, students become keenly aware of the standards they are expected to achieve, the products they are to produce, and the criteria for their assessment" (Davenport, et al., 1995, p. 61).

One of the primary concerns with interdisciplinary, integrated, and integrative models is how to maintain their alternative structure and how to evaluate them. What guidelines are necessary for teachers to appropriate the model in the intended way? An example of this problem is described by Shann (1977) in the evaluation of USMES, a Unified Science and Mathematics for Elementary Schools model meant to teach mathematics and science to students in a hands-on, problem-oriented approach. When the program was evaluated, however, most teachers merely used USMES activities as add-ons to their traditional mathematics and science lessons instead of as the driving force it was meant to be.

The other potential problem is what Jacobs (1989) calls the 'potpourri problem' where courses become a sampling of a little bit of this and a little bit of that without an overall, coherent structure or scope. The general consensus is that the choice of a theme or activity should promote "progress towards significant educational goals, not merely because it cuts across subject-matter lines" (Brophy & Alleman 1991, p. 66). There is, however, little agreement on which activities are fruitful for the pursuit of which educational goals.

JUSTIFICATIONS FOR INTEGRATION

In the act of representing curriculum in new configurations, there is the assumption that something is amiss with previous or current models. In what way do interdisciplinary, integrated, or integrative approaches improve on traditional approaches? Stember (1991) lists three current arguments that give support to interdisciplinary enterprises. These are: The 'intellectual argument,' which suggests that any field is enriched by ideas or methods from other fields; the 'practical argument,' which suggests that the real-world of knowledge is connected and new ties are formed every day; and the 'pedagogical argument,' which suggests that learning is seriously hindered by the current fragmented system.

As an organizational structure, interdisciplinarity promises to compensate "for global problems, change, information growth, and changing truth by utilizing all available resources" (Short & Jennings, Jr., 1976, p. 593). It is argued that in an interconnected, theme-based approach, teachers will have the flexibility to address the needs of the whole child. As a pedagogical strategy, individual and cultural differences, self-esteem, and rapidly changing information are seen as natural parts of the interdisciplinary process, not as 'units' that need to be added on as in traditional approaches. Additionally, "by focusing the curriculum on a problem or topic rather than on a discrete discipline, there is an increased opportunity to formalize the process of problem solving. By approaching a problem or topic from the vantage point of many teachers and/or disciplines, students are exposed to more information and more views, providing them with the raw material needed to construct understanding" (St Clair & Hough, 1992, p. 19).

Whether interdisciplinary, integrated, or integrative in approach, all three models claim the same positive educational outcomes. For students, these are:

- an increase in understanding, retention, and application of general concepts (Berlin, 1989; Berlin & White, 1994; Caine & Caine, 1991; Davison, et al., 1995; Fagan, 1987; Haigh & Rehfeld, 1995; Heath, 1989; IRA & NCTE, 1996; Krupnik-Gottlieb, 1995; Maurer, 1994; Moss, 1991; NCSSB, 1989; NCTM, 1989; NRA, 1996; Palmer, 1995; Pate, et al., 1995; St Clair & Hough, 1992; Vars, 1969; Wicklein & Schell, 1995);

- a better overall comprehension of global interdependencies, along with the development of multiple perspectives, points of view, and values (Ackerman, 1989; Aschbacher, 1991; Ast, 1995; Beane, 1991; Berlin, 1989; Boyer, 1991; Brady, 1989; Burns, 1995; Caine & Caine, 1991; Dybdahl & Shaw, 1993; Harter & Gehrke, 1989; IRA & NCTE, 1996; Martinello & Cook, 1994; Maurer, 1994; McDonald & Czerniak, 1994; Nielsen, 1989; NCSSB, 1989; NCTM, 1989; NCR, 1996; Relan & Kimpston, 1991; Short & Jennings, Jr., 1976; Squires, 1975; St Clair & Hough, 1992; Stevenson & Carr, 1993; Vars, 1969; White, 1981);

- an increase in the ability to make decisions, think critically and creatively, and synthesize knowledge beyond the disciplines (Aschbacher, 1991; Beane, 1991; Burns, 1995; Caissy, 1989; Cohen, 1978; Fagan, 1987; Harter & Gehrke, 1989; Heath, 1989; IRA & NCTE, 1996; Jacobs, 1989; Martinello & Cook, 1994; Maurer, 1994; McDonald & Czerniak, 1994; Moss, 1991; NCSSB, 1989; NCTM, 1989; NCR, 1996; Oberholtzer, 1937; Tchudi, 1991; Vars, 1969);

- the increased ability to identify, assess and transfer significant information needed for solving novel problems (Ackerman, 1989; IRA & NCTE, 1996; Jacobs, 1989; Krupnik-

Gottlieb, 1995; Maurer, 1994; NCSSB, 1989; NCR, 1996; NCTM, 1989; Nielsen, 1989; Relan & Kimpston, 1991; Vars, 1969; Wicklein & Schell, 1995);

- the promotion of cooperative learning, a better attitude towards self as a learner and as a meaningful member of a community (Ast, 1995; Beane, 1991; Davenport, et al., 1995; Dwyer, 1995; Harter & Gehrke, 1989; IRA & NCTE, 1996; Jacobs, 1989; Maurer, 1994; NCSSB, 1989; NCR, 1996; NCTM, 1989; Oberholtzer, 1937; Pate, et al., 1995; Pettus, 1994; Stevenson & Carr, 1993; Vars, 1969); and

- increased motivation (Aschbacher, 1991; Ast, 1995; Beane, 1991; Berlin, 1989; Berlin & White, 1994; Boyer, 1991; Caine & Caine, 1991; Davenport, et al., 1995; Davison, et al., 1995; Dwyer, 1995; Haigh & Rehfeld, 1995; Heath, 1989; IRA & NCTE, 1996; Jacobs, 1989; Kovalik & Olsen, 1994; Krupnik-Gottlieb, 1995; Maurer, 1994; McDonald & Czerniak, 1994; NCSSB, 1989; NCR, 1996; NCTM, 1989; Oberholtzer, 1937; Pettus, 1994; Relan & Kimpston, 1991; Squires, 1975; St Clair & Hough, 1992; Stevenson & Carr, 1993; Tchudi, 1991; Vars, 1969; Wicklein & Schell, 1995).

For teachers, the benefits are:

- improved and more meaningful relations with students (Aschbacher, 1991; Davenport, et al., 1995; Dwyer, 1995; Coate & White, 1996; Lewis, 1981; Vars, 1969);

- more curricular flexibility and less schedule and subject fragmentation (Ackerman, 1989; Beane, 1991; Burns, 1995; Dybdahl & Shaw, 1993; Jacobs, 1989; Lewis, 1981; Moss, 1991; Pate, et al., 1995; Short & Jennings, Jr., 1976; Vars, 1969);

- better overall integration of new and rapidly changing information with increased time efficiency (Brady, 1989; Burns, 1995; Caissy, 1989; Dwyer, 1995; Dybdahl & Shaw, 1993; Jacobs, 1989; Lewis, 1981; McDonald & Czerniak, 1994; Nielsen, 1989; Short & Jennings, Jr., 1976; White, 1981);

- better collegiality and support between teachers and wider comprehension of the connections between disciplines (Aschbacher, 1991; Burns, 1995; Dwyer, 1995; Lewis, 1981; Scarborough, 1993a; St Clair & Hough, 1992; Wicklein & Schell, 1995);

- support from research on the human brain and the learning process (Brady, 1989; Caine & Caine, 1991; Dwyer, 1995; Herrold, Jr., 1989; Kovalik & Olsen, 1994; Shoemaker, 1989; St Clair & Hough, 1992; Relan & Kimpston, 1991); and

- relevance to the needs of the twenty-first century and support from National Standards (Berlin, 1990; Berlin & White, 1994; Brunkhorst, 1991; Burns, 1995; Caissy, 1989; Davison, et al., 1995; Dwyer, 1995; Dybdahl & Shaw, 1993; House, 1990; Lonning & DeFranco, 1994; Moss, 1991; Shoemaker, 1989).

In the face of great similarities across the models, some differences in justifications do exist. These tend to lie along a continuum of the level of importance placed on such objectives as whether learning should primarily enhance the affective needs or the cognitive skills of the learner; whether a general education is more valid than in-depth coverage of primary disciplines; whether themes and issues or the content of the disciplines should be the foundation of integrative threads; or whether the locus of control over curricular content should be held by administrators, teachers, or teachers and students. In other words, who decides what knowledge and how it is presented to students constitute the main differences among models. The three models presented in Table 1 illustrate the different valuings along these dimensions.

THE PROCESS OF INTEGRATION

Is one of the three approaches the best approach? Probably not. However, the prevalence of interdisciplinary models over either integrated or integrative models suggests the changes needed to implement an interdisciplinary approach are more in line with traditional curriculum and pedagogy. This may be because changes that disturb current structures the least are more likely to be accepted than changes that result from or demand a complete restructuring (Marris, 1986; Fullan, 1991). Consistent with interdisciplinarity is a combining or adding-on strategy that makes use of material already present in the curriculum.

On the other hand, integrated and integrative curriculum require a complete restructuring or reconceptualization of what is meant by learning and teaching. Working within a framework of uncertainties is not easy. Especially in an integrative approach, where not only teachers but students are well enculturated in the traditional authoritarian teaching-learning model, it is difficult to invest the time required to feel comfortable with and trust new roles, goals, and interactions. Jacobs infers that the biggest reason for the failure to establish an integrated curriculum is that teachers try too much too quickly and don't provide transitional time for themselves and their students (in Brandt, 1991). While an interdisciplinary model involves relatively little risk, an integrated or integrative approach involves a great deal of risk.

Drake (1991) describes the stages teachers from different disciplines went through in creating

an integrated curriculum. Teachers collaborated, but also worked to ensure their particular discipline was 'properly' represented. Then, as each teacher was exposed to other teachers' perspectives and disciplines, their conceptual vision expanded to include the others' points of view. And finally, as Drake puts it, they were becoming 'connection experts' rather than 'subject experts': "When we began to trust our own experience, we found that the boundaries dissolved in many different areas" (Drake, 1991, p. 20). After observing this process Drake concluded that interdisciplinarity might be a necessary step before being able to envision an integrated model.

In forming interdisciplinary units, most teachers find it very hard to give up strategies, structures, and content that they are most familiar with (Drake, 1991; Fullan, 1991; Palmer, 1995). Deciding what strategies to use and what content to replace or retain within a context of conflicting theories is just one of the dilemmas facing even interested teachers. Some theorists (Berlin & White, 1994; Gozzer, 1982) state explicitly that integration should not be made at the expense of knowing the disciplines well, while others (Boyer, 1991; Beane, 1995; Brady, 1989) feel that instilling in students the desire to learn, to care, and to pursue a general education that promotes understanding of global interdependencies is more important than covering a vast body of facts. Most, however, seek a common ground that provides opportunities for going beyond the disciplines while maintaining quality coverage of disciplinary content. This may be one reason for the more common combinations of mathematics and science; social studies and language arts; and science, technology and society. These combinations all have espoused common ground, whether in the form of content, educational objectives, or modes of inquiry. Combining disciplines that already share characteristics makes sense, or maybe, as Cohen (1978) believes, a natural evolutionary course for the disciplines.

The Context of Integration

The push for interdisciplinarity or integration incorporates many of the trends that have become part of the recent discussions of educational restructuring—shared goals, flexible scheduling, site-based decision-making, collegiality, and outcome-based assessment. Whether interdisciplinarity is a logical outcome of more teacher discussion and teamwork, or whether the objectives that drive

integrated approaches have motivated teachers to work together is not important to this discussion. Nevertheless, the most cited conditions for success in interdisciplinary approaches cohere with these trends. 'Success' stories in the interdisciplinary/integrated literature cite the following conditions as necessary for the adoption of new curricular models to occur: continued participation in and ownership of the curricular design; the flexibility to explore different models and make adjustments when needed; consistent and continual time for planning and discussion; and access to resources, resource groups, feedback, and adequate interpersonal training (Anderson, 1995; Aschbacher, 1991; Banks & Stave, 1994; Beane, 1991, 1992, 1995; Braunger & Hart-Landsberg, 1994; Bybee & Bonnstetter, 1987; Coate & White, 1996; Davenport & Jaeger, 1995; Drake, 1991; Haigh & Rehfeld, 1995; Harter & Gehrke, 1989; Jacobs, 1989; Kovalik & Olsen, 1994; Lehman, 1994; Lewis, 1981; Lonning & DeFranco, 1994; Marzano, 1992; Maurer, 1994; McDonald & Czerniak, 1994; Moss, 1991; NCSSB, 1989; NCTM, 1989; NRC, 1996; Nielsen, 1989; Oja, et al., 1995; Palmer, 1991; Quattrone, 1989; Romey, 1975; Scarborough, 1993b; Stevenson & Carr, 1993; Tchudi, 1991; Wicklein & Schell, 1995; Yager, et al., 1981; Zarnowski, 1994). Therefore, as would be expected, lack of administrative support, as well as lack of suitable skills and training for collaboration, have been cited as primary reasons for the failure of teachers to conceptualize interdisciplinary approaches or to maintain them once developed (House, 1990; Leman, 1994; Lonning & DeFranco, 1994: Nielsen, 1989).

However, difficulties in the implementation of interdisciplinary or integrated approaches do not lie solely with teachers. Teachers report their students were unable to overcome their dependence on disciplinary knowledge; had difficulty with unfamiliar open-ended tasks; and were either reluctant or unable to discuss information at deeper levels (Anderson, 1995; Jacobs, 1989; Wicklein & Schell, 1995). Parents are also concerned their children did not learn enough facts (Pate, et al., 1995), and that such approaches would lower their chances at getting into Ivy-league universities (Anderson, 1995).

Conclusion

This review of literature on interdisciplinary studies in K-12 curriculum illustrates the complex nature of such studies. In fact, three approaches to combining disciplines/content have been discerned—interdisciplinary, integrated and integrative studies. These approaches share much in common (the advocacy of connected rather than separate disciplines; active inquiry rather than passive rote learning; authentic, student-centered curriculum instead of a discipline-centered one) but differ in important ways (the relative importance of disciplinary knowledge; the role of the teacher; the value of personal knowledge and experience). Clearly, the most prevalent of these approaches is interdisciplinary studies, which require the least change to current teaching and curriculum, while integrated and integrative approaches depart more significantly from teaching and curriculum as we know it, and thus are less common. All three approaches are, however, advocated in the literature.

These three approaches share many expectations about the positive outcomes that will ensue for students and teachers. And, generally, those who have or are doing interdisciplinary, integrated or integrative studies judge their experiences positively. However, little evidence is provided that illustrates whether these outcomes actually occur, what the differences between approaches are, and whether positive outcomes are attributed more to the deeper understandings presumed as the result of combining disciplines or to the pedagogical strategies (e.g., problem solving, theme oriented) used (Gibbons, 1979; Pring, 1973; Relan & Kimpston, 1991; St Clair & Hough, 1992). "Missing from these accounts is an analysis of the underlying factors which caused a particular amalgamation of disciplines to succeed" (Relan & Kimpston, 1991, p. 6).

Many justifications given for interdisciplinary studies are related to practical matters of curriculum and teaching. Interdisciplinary, integrated, and integrative studies represent an opportunity to: have more meaningful relations with students; teach cognitive skills associated with 'real life' (e.g., cooperation, problem solving, ability to see connections); motivate students; increase student achievement; promote positive attitudes toward subject matter; create more curricular flexibility; diminish scheduling problems; and integrate new and rapidly changing information with increased time efficiency.

Less often, justifications are based on content or epistemology issues. It is the case, though, that science and mathematics integrations are more likely to be justified on the basis of their presumed

common modes of inquiry. And social studies and language arts integrations are more likely to be justified based on the commonality of objectives. The justification based on the existence of unifying themes crosses all disciplines.

This distinction between practical matters of curriculum/teaching and content/ epistemology is not meant to diminish either. There can be little doubt that pragmatic concerns are paramount in determining the nature of what is taught and how in schools. What is noteworthy is the prominence of these justifications **over** ones based on disciplinary knowledge structures or modes of inquiry that lead to those knowledge structures. This suggests that interdisciplinary studies have a practical appeal but that there has been too little attention to issues of what is integrated and how.

This review reveals what researchers who argue for interdisciplinary studies think they are, what they will achieve, and where these ideas came from. Many questions remain unanswered, though. These are questions about what is really happening in interdisciplinary/integrated/ integrative classes—about which of the three approaches works better and under what circumstances? about what the impact on teaching is? about whether the assumptions made about combining disciplines are good ones? We raise these questions not to be critical, but in the hope of moving the discourse and research on interdisciplinarity further along in the quest for truly educative experiences in schools.

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